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569i

Department of Energy
Post Office Box 2567
Grand Junction, Colorado 81502-2567

July 31, 1989

Mr. Steve Peacock
U.S. Army Corps of Engineers
Federal Building, Room 8402
125 South State Street
Salt Lake City, Utah 81438

SUBJECT: Monticello Remedial Action Project, Wetlands Determination For
Montezuma Creek and Adjacent Area, San Juan County, Near
Monticello, Utah

Dear Mr. Peacock:

As per your telephone conversation with UNC Geotech personnel July 25, 1989, the U.S. Department of Energy is requesting that a wetlands determination be completed for Montezuma Creek from State Highway 191 to the confluence with Vega Creek and an area adjacent legally described as Section 8 and the West one-half of Section 5, Township 34 South, Range 24 East, of the Salt Lake Basin Meridian.

We understand the wetlands determination will be made in concert with the U.S. Fish and Wildlife Service in regards to Section 7 coordination and that UNC Geotech personnel will be available for assistance during your field investigation.

It is anticipated that your wetlands determination will commence on or about August 23, 1989, and will be completed by September 1, 1989.

This request for wetlands determination is necessary and prudent in order that the laws, regulations and policies of Section 404 of the Clean Water Act, Section 7 of the Endangered Species Act, Executive Order 11988, and internal U.S. Department of Energy regulations (specifically, 10 CFR 1022) are properly addressed and complied with. The determination will also help us in properly assessing the need for an individual 404 permit or application of "supplemental standards" as further defined by the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978.

Enclosed is a map of the area with appropriate highlighting indicating the portion of Montezuma Creek and adjacent areas to be included in this request for a Wetlands Determination.

Williamson/kb
/ /89

Tucker
/ /89

Hollowell
/ /89

MRAP-0011 AR 569i 4-13 OTHER CORRES
CORRESPONDENCE BETWEEN THE DOE AND OTHERS.
COE AND EPA 89-2000 3 DOCUMENTS

Mr. Steve Peacock

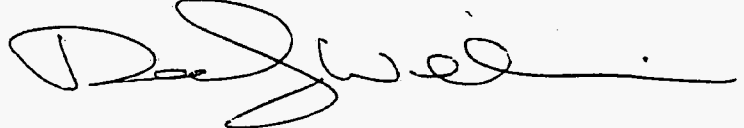
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July 31, 1989

We appreciate the U.S. Army Corps of Engineers assistance with this project and look forward to the results of your investigation.

If you have any questions or if I can be of further assistance, please contact me at (303) 248-6009.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Dee J. Williamson', with a long horizontal flourish extending to the right.

Dee J. Williamson
Monticello Project Manager
Grand Junction Projects Office

Enclosure:
As stated

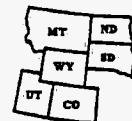
cc: W. Murphie - NE-23/GTN
G. Bowman - DOE/ID
R. Throckmorton - DOE/ID
R. Nace - Weston/OTS
L. Nguyen - EPA/Denver
B. Mcleod - State of Utah

L-SP7.25/dw



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII

999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

Region VIII

NOV 13 1997

Ref: 8EPR-PS

MEMORANDUM

SUBJECT: Results and Interpretation of Exposures to Radionuclides and Other Metals in Tissues of Deer and Beef from Montezuma Creek, UT; Monticello OU3 Site

FROM: Gerry M. Henningsen, DVM, PhD, DABT/DABVT; CAPT, USPHS
Regional Senior Toxicologist and Co-Chair, Region 8 ETAG

TO: Paul Mushovic, 8EPR-FF
RPM, Monticello NPL Site

After recently obtaining the electronic results from NAREL staff on beef and deer results for radionuclide concentrations (reported as gamma radiation activity in pCi/g wet-weight), I was able to analyze the data and draw conclusions for exposure and risks at Monticello OU3. Please refer to the attached draft protocol from last May 28, 1996, as well as to the newer attached materials that contain summary results. Some additional analyses are recommended for long-bones and antlers. Per the May 1996 memo (discussed at ETAG meetings) and the 1996 QAPP, this limited study is only appropriate for obtaining exposure data that is site-specific. The two results of this well-conducted study can only, and do, support the following conclusions regarding exposure (and not necessarily for *quantitating* risk to human health):

1. **Edible** soft-tissue concentrations of both radionuclides and other metals in OU3 site-exposed animals were **similar** to background levels;

conclude: *there are no significant elevations of contaminants in edible tissues, thus no excess human exposure and no hazard or risks (semi-quantitatively) exist from site contaminants via this exposure route (meat ingestion).*

2. **Bone** (rib) concentrations of certain radionuclides (Ra-226, Bi-214, Pb-214) are **slightly higher in exposed cattle** (but not in deer) than are background levels for reference cattle;

conclude: some radionuclide contaminants in exposed (primarily upper/middle canyon) cattle bones are elevated just above trace background levels, near detection limits, denoting small levels of site-related uptake in cattle (does not pose an excess risk to consumers) wherein the bones serve as biomarkers of exposure (not effects); **subsets of cattle long-bones warrant further limited study to confirm and reproduce radionuclide results in ribs.**



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It remains imperative for everyone to understand that this limited exposure study of tissue-residues was designed for the sole purpose of **screening out** the possibility of significantly elevated exposure to contaminants through a food ingestion pathway. Such risks were modeled in the human baseline risk assessment and found to be acceptably low, but contained substantial uncertainties. Results of this study support the model predictions and earlier professional biomedical opinions that one would not expect any substantial edible-tissue accumulation. However, the uncertainty of biokinetics (uptake, distribution, half-lives) for some metals, radionuclides, and various isotopes made it prudent to confirm the suspected absence of site contaminants in the edible tissues of beef and deer. Pre-existing data and models were judged as too weak for valid and convincing predictions of tissue concentrations in exposed deer and beef that graze in Montezuma Creek where low-level contamination remains. Likewise, a more rigorous and statistically strong scientific study of contaminant tissue loading was unwarranted based on the low likelihood that any tissues would harbor site contaminants at elevated levels of health risk concern. Collection of site-specific exposure data by measuring edible tissue concentrations of COCs in site-exposed and reference cattle and deer (to the limited but adequate extent in this study) was felt by toxicologists at EPA and UDEQ to be a preferential approach (vs modeling only) for applying resources with prospective usefulness of the results on low-level exposures in OU3. The study turned out to be sufficient and conclusive for the above purposes, and it provided good cost-benefit for balancing health risk investigations with limited resources.

The null hypothesis to test with the study data and to try to scientifically and statistically disprove was stated as follows:

Tissue concentrations of contaminants of concern (4 radionuclides and 4 other metals) are the same in deer and cattle grazed in or near Montezuma Creek when compared to deer and cattle grazed in reference areas (as analyzed in muscle, liver, kidney and bone).

The statistical test used was a **one-tailed t-test** for comparing two groups (or *protected ANOVA* for multiple groups) for each tissue and contaminant combination (a two-tailed t-test was not used since any site-related change should only be in one direction above background levels). If a statistical probability of $\alpha \leq 0.05$ resulted for exposed tissue levels being higher than controls, then the null hypothesis was rejected and one concludes that significant difference exists between the groups for a particular tissue type and contaminant. Thus, with this scenario for edible soft-tissues, potential excess human exposure via this meat ingestion route could not be screened out. Conversely, if $\alpha \geq 0.05$ is found for all tissue and contaminant combinations in a study that is reasonably well conducted, then the above null hypothesis is accepted and exposure via this route is able to be screened out with no further risk-based evaluation being necessary.

Preliminary results are included in the attachments and can be summarized as briefly described below (see the recent electronic spreadsheets for more details on data and results):

- Attachment 1: This spreadsheet shows 3 sets (per canyon location) of vertical columns of results for **all detected radionuclides in beef bones**. Duplicates are shaded in cells. Beef from the Upper/middle canyon of Montezuma Creek had higher levels of Bi-214, Pb-214, and Ra-226 in their rib bones (Pb-214 and Ra-226 were statistically significant) compared to cattle from the lower canyon and/or the control Verdure Creek canyon. NAREL reports that Bi-214 and Pb-214 are decay products of Ra-226 and can help provide lower detection capability for Ra-226 whose readings can be interfered with by U-235 (not detected in any samples). All other radionuclides were similar among groups. Full statistical comparisons were limited since the MDCs (minimal detectable concentrations) were only reported for Ra-226 and not for other non-detected radionuclide COCs. Blocks at the bottom of the spreadsheet page denote a subset of cattle sample numbers that are recommended for further analyses of long-bones by NAREL, to confirm findings in ribs; beef were selected that had highest bone gamma readings, plus 1 beef was chosen from each of 3 groups with the highest soft tissue gamma readings (i.e., CU10, CL4 and CV5).
- Attachment 2: This spreadsheet contains **statistical analyses** of the results which shows that significant, but small, differences existed in bone levels of Pb-214 and Ra-226 -- elevated in cattle from the Upper/middle canyon of Montezuma Creek. One half of the MDC was substituted for non-detected Ra-226 when performing the statistical tests.
- Attachment 3: This spreadsheet shows all radionuclide detections (fewer compared to beef) in **deer bones**; the bucks are highlighted, since the site animals had deformed antlers which are being considered for further analyses. Duplicate results are shaded in cells.
- Attachment 4: This spreadsheet shows all radionuclide results for edible **beef soft-tissues** in the top portion, and the MDCs for Ra-226 are shown in the bottom portion. There were no meaningful detected elevations above background or as compared to Ra-226 MDCs.
- Attachment 5: This E-mail message from Nov 15, 1996, summarizes negative findings of elevated **metals** in edible beef tissues, which was the identical finding for edible deer tissues. Two spreadsheets with summary results for metals are included with the message.
- Attachment 6: This memo proposes the **risk-based scientific protocol** for the investigation of exposed deer and beef; this study can be reviewed in more and final detail in the 1996 EPA QAPP (Quality Assurance Project Plan).

Recommendations to risk managers for final minor risk assessment work at Monticello include:

1. That Accu-Labs in Golden process (weigh, dry, ash) 11 samples of long-bones (F code = femur) from beef and 4 antlers (A code) from deer for **analyses of metal COCs** as before, with the addition of calcium and phosphorus to be analyzed in the antlers. EPA sample numbers to test are: a) Upper = CU2F, CU7F, CU8F, CU9F, CU10F; b) lower = CL1F, CL3F, CL4F; c) control = CV3F, CV4F, CV5F; and deer = DS2A, DS5A, DV2A, DV6A.

2. That EPA's NAREL analyze the above bone and antler samples (15 total) for the suite of COC **radionuclides** as performed previously on the initial samples for this study. Request MDCs on Ra-226, Pb-214 and Bi-214. Results are needed to confirm and correlate the larger bone mass findings with the recent radiation results in ribs.
3. That DOE and/or EPA derive improved (vs default literature) estimates of site-specific biological concentration factors (BCFs) of certain COCs from soil/water and vegetation to beef. This task is possible with these data and is needed for potential future use in models designed to estimate human exposure through a similar beef ingestion pathway; also, site BCFs could be used to improve current model assumptions and predictions.
4. That these results be presented as planned at the 1998 Society of Toxicology meeting, and then **published** to report the amounts of tissue burdens and distributions of radionuclides in cattle and deer that are exposed to known low-level concentrations of these site radionuclides and metals via forage, soil and water contamination for chronic durations.
5. That EPA, UDEQ and UDOW work jointly on a small study next fall 1998 to evaluate potential **causes of deformed antlers** in bucks that are exposed to contaminants at the site. Minimal effort and cost would be involved to trap or tranquilize and then sample and euthanize site and reference yearling bucks. Clinical chemistries, clinical toxicology, and diagnostic histopathology should be performed on samples of fresh blood, antlers in velvet, testicles, etc. Further COC analyses are not likely to be needed.

attachments:

1. Radionuclides in Cattle Bones
2. Statistics for Radionuclides in Cattle Bones
3. Radionuclides in Deer Bones
4. Radionuclides in Cattle Soft-Tissues
5. Metal COCs in Edible Tissues of Deer and Beef
6. Scientific Protocol

copies:

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Jay Silvernale, 8EPR-FF
Steve Callio, 8TMS-Q
Scott Everett, UDEQ
Ben Morris, UDOW
Clay Carpenter, RUST
Mark Wickstrom, New Zealand

Bone Gamma-Radiation in Beef at the Monticello, UT, NPL Site, 1996

Cattle Upper MC	Radio- nuclide	EPA# n=10	Results wet wt pCi/g	Field dupl: 2=11	Cattle Lower MC	Radio- nuclide	EPA# n=6	Results wet wt pCi/g	Field dupl: 5=7	Cattle Verdure controls	Radio- nuclide	EPA# n=7	Results wet wt pCi/g	Field dupl: 1=6
	BI-212					BI-212	CL1R	0.159						
	BI-214	CU10R	0.12			BI-214	CL1R	0.112						
Mean	0.189	CU11R	dup				CL3R	0.148						
		CU1R	0.133	0.29										
		CU2R	0.29											
		CU3R	0.106											
		CU4R	0.128											
		CU5R	0.116											
		CU7R	0.27											
		CU8R	0.239											
		CU9R	0.199											
	K-40	CU10R	0.512			K-40	CL1R	0.884			K-40	CV1R	0.99	1.25
		CU11R	dup				CL2R	0.975				CV2R	1.1	
		CU1R	1.23				CL3R	1				CV3R	0.984	
		CU2R	1.26	0.97			CL4R	0.914				CV4R	0.937	1.07
		CU3R	1.1				CL5R	1.09				CV4R D	dup	NAREL
		CU4R	0.839				CL6R	1.06	0.91			CV5R	0.648	
		CU5R	0.986				CL7R	dup				CV6R	1.23	
		CU6R	1.2									CV7R	1.16	
		CU7R	1									CV8R	dup	
		CU8R	0.809											
		CU9R	0.952											
	PA-234M	CU8R	1.59											
	PB-212	CU11R	dup			PB-212	CL1R	0.0537			PB-212	CV1R	0.0464	ND
		CU1R	0.0277				CL2R	0.0279				CV4R	0.016	0.013
Mean	0.046	CU2R	0.064	0.062			CL3R	0.0465				CV4R D	dup	NAREL
		CU3R	0.0729				CL4R	0.0572				CV5R	0.0832	
		CU4R	0.0464				CL5R	0.0237				CV6R	0.0697	
		CU5R	0.0193				CL6R	0.0295	ND					
		CU6R	0.0409									Mean	0.064	
		CU7R	0.0315											
		CU8R	0.0582				Mean	0.040						
	PB-214	CU10R	0.107			PB-214	CL1R	0.104			PB-214	CV1R	0.034	ND
Mean	0.194	CU11R	dup				CL3R	0.14						
p<0.02		CU1R	0.157	0.29			CL5R	0.064						
		CU2R	0.319				CL6R	0.0654	ND					
		CU3R	0.166											
		CU4R	0.13											
		CU5R	0.107											
		CU6R	0.228											
		CU7R	0.229											
		CU8R	0.278											
		CU9R	0.22											
	RA-226	CU10R	0.915			RA-226	CL1R	0.701			RA-226	CV2R	0.276	
Mean	0.833	CU11R	dup				CL3R	0.484				CV5R	0.926	
p<0.01		CU1R	0.447	0.89			CL4R	0.64				CV6R	0.423	
		CU2R	0.72				CL5R	0.374						
		CU3R	0.807				CL6R	0.345	0.29			Mean	0.642	
		CU4R	0.231				CL7R	dup				1 MDC =	0.5	
		CU5R	0.543									3 MDC =	0.71	
		CU6R	1.45									4 MDC =	0.38	
		CU7R	1.18									7 MDC =	0.65	
		CU8R	0.848											
		CU9R	1.19											
	RA-228	CU11R	dup			RA-228	CL1R	0.168			RA-228	CV4R	0.0979	
		CU2R	0.13	0.14								CV8R	0.124	
	TH-234	CU4R	0.624								TH-234	CV4R	0.373	
	TL-208	CU11R	dup			TL-208	CL1R	0.0141			TL-208	CV2R	0.0103	
		CU1R	0.0133				CL5R	0.0147				CV3R	0.0426	
		CU2R	0.0256	0.035			CL7R	0.0222						
recheck Beef # 2,7,8,9,10		CU5R	0.0165		recheck Beef # 1,3,4					recheck Beef # 3,4,6				
		CU7R	0.0251											
		CU8R	0.0254											

Statistical Analyses on Bone Gamma-Radiation in Beef at the Monticello, UT, NPL Site, 1996

Radio-nuclide	EPA# n=10	Results wet wt pCi/g	Results wet wt pCi/g	Results wet wt pCi/g	Cattle Lower MC	Radio-nuclide	EPA# n=6	Cattle Verdure controls	Radio-nuclide	EPA# n=7								
		Upper	Lower	Control														
BI-214	CU10R	0.12	0.112			BI-214	CL1R											
	CU1R	0.133	0.148				CL3R											
	CU2R	0.29																
	CU3R	0.106																
	CU4R	0.128																
	CU5R	0.116																
	CU7R	0.27																
	CU8R	0.239																
	CU9R	0.199																
		Upper	Lower	Control														
K-40	CU10R	0.512	0.884	0.99		K-40	CL1R		K-40	CV1R								
	CU1R	1.23	0.975	1.1			CL2R			CV2R								
	CU2R	1.26	1	0.984			CL3R			CV3R								
	CU3R	1.1	0.914	0.937			CL4R			CV4R								
	CU4R	0.839	1.09	0.648			CL5R			CV5R								
	CU5R	0.986	1.06	1.23			CL6R			CV6R								
	CU6R	1.2		1.16						CV7R								
	CU7R	1																
	CU8R	0.809																
	CU9R	0.952																
		Upper	Lower	Control														
PB-212	CU1R	0.0277	0.0537	0.0464		PB-212	CL1R		PB-212	CV1R								
	CU2R	0.064	0.0279	0.016			CL2R			CV4R								
	CU3R	0.0729	0.0465	0.0832			CL3R			CV5R								
	CU4R	0.0464	0.0572	0.0697			CL4R			CV6R								
	CU5R	0.0193	0.0237				CL5R											
	CU6R	0.0409	0.0295				CL6R											
	CU7R	0.0315																
	CU8R	0.0582																
		Upper	Lower	Control														
PB-214	CU10R	0.107	0.104	0.034		PB-214	CL1R		PB-214	CV1R								
	CU1R	0.157	0.14				CL3R											
	CU2R	0.319	0.064				CL5R											
	CU3R	0.166	0.0654				CL6R											
	CU4R	0.13																
	CU5R	0.107																
	CU6R	0.228																
	CU7R	0.229																
	CU8R	0.278																
	CU9R	0.22																
		Upper	Lower	Control														
RA-226	CU10R	0.915	0.701	0.278		RA-226	CL1R		RA-226	CV2R								
	CU1R	0.447	0.484	0.926			CL3R			CV5R								
	CU2R	0.72	0.64	0.423			CL4R			CV6R								
	CU3R	0.807	0.374	0.25			CL5R											
	CU4R	0.231	0.345	0.355			CL6R											
	CU5R	0.543	0.28	0.191														
	CU6R	1.45		0.323														
	CU7R	1.18																
	CU8R	0.846																
	CU9R	1.19																
		Upper	Lower	Control														

gamma results
11/10/97

prepared by: Gerry Henningsen

EPA R8, Denver, CO

Attachment 1

Bone Gamma-Radiation in Deer at the Monticello, UT, NPL Site, 1996

<u>Deer</u> MC Site	Radio- nuclide	EPA# n=6	Results wet wt pCi/g	Field dupl: 3=7		<u>Deer</u> Verdure controls	Radio- nuclide	EPA# n=6	Results wet wt pCi/g	Field dupl: 1=7
	BI-214	DS1R	0.746							
buck	K-40	DS1R	1.44			buck	K-40	DV1R	1.78	1.91
		DS2R	1.86					DV2R	1.82	
		DS3R	2.24	2.2				DV3R	2.73	
buck		DS4R	1.13			buck		DV4R	1.23	
		DS5R	1.79					DV5R	1.56	
		DS6R	1.64	1.97				DV6R	1.63	
		DS6R D	dup	NAREL				DV7R	dup	
		DS7R	2.2							
	PB-212	DS2R	0.114				PB-212	DV1R	0.0498	0.035
		DS3R	0.0607	ND				DV5R	0.0516	
		DS4R	0.0559					DV7R	dup	
	PB-214	DS1R	0.703							
	RA-226	DS1R	1.06							
	TH-234	DS5R	1.43				TH-234	DV7R	1.17	
	TL-208	DS2R	0.0455				TL-208	DV1R	0.0396	ND
		DS4R	0.0675					DV6R	0.0838	
		DS6R	0.0431							
DS1R	repeated					DV4R	repeated			

Gamma Radiation Detections in Muscle (m), Liver (h) and Kidney (k) from Beef near Monticello NPL Site, UT, 1996														
Radionuclides in Cattle (C) are listed in alpha-numeric order by location: CL = Lower canyon, CU = Upper/Middle canyon, CV = Verdure canyon														
CONCLUSIONS: Exposures in Soft Edible Tissues is at Background Levels!														
Locale	Radio-nuclide	EPA # n = 6	Gamma pCi/g	tissue	Locale	Radio-nuclide	EPA # n = 10	Gamma pCi/g	tissue	Locale	Radio-nuclide	EPA # n = 7	Gamma pCi/g	tissue
CL	BI-212	CL3K	0.111	k	CU	BI-212	CU3M	0.0579	m	CV	BI-212	CV5H	0.117	h
CL	BI-214	CL6M	0.0189	m	CU	BI-214	CU10K	0.0342	k	CV	BI-214	CV2K	0.0176	k
CL	PB-212	CL3K	0.015	k	CU	BI-216	CU5K	0.0127	k	CV	BI-215	CV5H	0.057	h
CL	PB-213	CL4K	0.0321	k	CU	PB-212	CU1H	0.012	h	CV	BI-216	CV6K	0.0362	k
CL	PB-214	CL4H	0.0239	h	CU	PB-213	CU1K	0.00825	k	CV	PA-234M	CV4H	1.21	h
CL	PB-215	CL6M	0.0281	m	CU	PB-214	CU10K	0.0369	k	CV	PA-234M	CV6M	1.33	m
CL	RA-226	CL4H	0.133	h	CU	PB-214	CU2H	0.0181	h	CV	PB-212	CV5H	0.0461	h
CL	TL-208	CL3H	0.0119	h	CU	PB-215	CU2M	0.0181	m	CV	PB-213	CV5M	0.0228	m
CL	TL-209	CL4K	0.012	k	CU	PB-216	CU4K	0.0235	k	CV	PB-214	CV5H	0.0393	h
CL	TL-210	CL6K	0.0101	k	CU	PB-216	CU4K	0.037	k	CV	PB-214	CV6K	0.0153	k
					CU	PB-217	CU7K	0.0201	k	CV	PB-215	CV5K	0.0347	k
					CU	PB-217	CU8M	0.0632	m	CV	PB-216	CV6K	0.0308	k
					CU	RA-226	CU5H	0.158	h	CV	PB-216	CV7H	0.0226	h
					CU	TL-208	CU2M	0.0188	m	CV	PB-217	CV7M	0.02	m
					CU	TL-209	CU6H	0.025	h	CV	TL-208	CV5H	0.0234	h
Highest Beef with Ra-226, or BI-214 or Pb-214					CU	TL-210	CU7H	0.0171	h	CV	TL-209	CV7H	0.0131	h
					CU	TL-211	CU8M	0.0339	m					
	CL4					CU10					CV5			
	Rib Ra-226 = .64 vs .51 mean					Rib Ra-226 = .92 vs .83 mean					Rib Ra-226 = .93 vs .54 mean			
non-detects for Ra-226 =														
CL1H	h	0.494			CU10H	h	0.202			CV1H	h	0.348		
CL2H	h	0.213			CU11H	h	0.372			CV2H	h	0.482		
CL3H	h	0.263			CU1H	h	0.238			CV3H	h	0.193		
CL5H	h	0.192	liver		CU2H	h	0.218	liver		CV4H	h	0.209	liver	
CL6H	h	0.27	average =		CU3H	h	0.244	average =		CV5H	h	0.273	average =	
CL7H	h	0.275	0.285		CU4H	h	0.218	0.321		CV6H	h	0.187	0.286	
					CU6H	h	0.887			CV7H	h	0.227		
					CU7H	h	0.393			CV8H	h	0.369		
					CU8H	h	0.24							
					CU9H	h	0.196							
CL1K	k	0.264			CU10K	k	0.258			CV1K	k	0.281		
CL2K	k	0.245			CU11K	k	0.263			CV2K	k	0.19		
CL3K	k	0.241			CU1K	k	0.195			CV3K	k	0.289		
CL4K	k	0.267			CU2K	k	0.313			CV4K	k	0.188		
CL5K	k	0.182	kidney		CU3K	k	0.256	kidney		CV5K	k	0.218	kidney	
CL6K	k	0.235	average =		CU4K	k	0.272	average =		CV6K	k	0.248	average =	
CL7K	k	0.221	0.236		CU5K	k	0.188	0.260		CV7K	k	0.219	0.246	
					CU6K	k	0.219			CV8K	k	0.331		
					CU7K	k	0.286							
					CU8K	k	0.329							
					CU9K	k	0.279							
CL1M	m	0.22			CU10M	m	0.339			CV1M	m	0.242		
CL2M	m	0.243			CU11M	m	0.244			CV2M	m	0.461		
CL3M	m	0.211			CU1M	m	1.06			CV3M	m	0.323		
CL4M	m	0.257	muscle		CU2M	m	0.332	muscle		CV4M	m	0.408	muscle	
CL5M	m	0.336	average =		CU3M	m	0.193	average =		CV5M	m	0.422	average =	
CL6M	m	0.243	0.279		CU4M	m	0.205	0.475		CV6M	m	0.418	0.392	
CL7M	m	0.442			CU5M	m	0.98			CV7M	m	0.431		
					CU6M	m	0.429			CV8M	m	0.429		
					CU7M	m	0.248							
					CU8M	m	0.853							
					CU9M	m	0.345							
Total Average =		0.266	(rib non-detect = .53)		Total Average =		0.353	(all ribs detected)		Total Average =		0.308	(rib non-detects = .52)	

Copy of Email Message with summary of Metals Analyses for Beef and Deer at Monticello

From: <HENNINGSEN.GERRY@epamail.epa.gov>
Date: Fri, 15 Nov 96 18:21:14 EST
Message-Id: <9610158481.AA848117711@lancelot.rtptok.epa.gov>
To: Scott Everett <eqerr.severett@state.ut.us>
Cc: MUSHOVIC.PAUL@epamail.epa.gov, ROBLES.MARIO@epamail.epa.gov,
GRAHAM.RICHARDV@epamail.epa.gov, CALLIO.STEVEN@epamail.epa.gov,
GRIFFIN.SUSAN@epamail.epa.gov, WEIS.CHRIS@epamail.epa.gov,
GINDELBERGER.JIM@epamail.epa.gov, SILVERNALE.JAY@epamail.epa.gov
Subject: Montizuma Creek Beef Results and Interim Conclusions!

Hi Scott,

Attached is a Excel 5.0 file with 2 pages of summary data on the beef muscle and liver results for the Monticello NPL site.

The results are GOOD NEWS in that there are no significant elevations in COCs in edible tissues (especially for U and Th, which were all non-detectable) between groups of cattle, in terms of liver and muscle concentrations based on wet weights. Therefore, the meat can be safely released for sale by Al Frost, without any concern for excess public health risks from eating the meat from the exposed cattle. There were only 2 cattle in the middle canyon that had some low metal detections in muscle, besides zinc which appeared in every sample. One liver sample apparently needs to be rerun (the only sample with no detected metals, and with its duplicate having metals), which I hope Jim G. and Steve C. can get done. We are getting dry-weight based results next week from the lab. AccuLabs in Golden, CO, did the analyses. It will be interesting to see what the bone samples from beef and the deer tissues reveal, as far as "exposure" to the COCs. I gave hard-copies to Paul, if anyone in R8 can't read the electronic files and wants to see the spreadsheet tables. I'll be in DC at SETAC next week, and will be back to EPA on Nov 25, for discussing findings.

Gerry Henningsen, DVM, PhD, DABT/DABVT; R8 Toxicologist

NOTE: Deer tissue samples for metals also showed no site-related elevations in levels when compared to the reference area; most metal concentrations were low and near the method detection limits, except for the nutrient zinc (which is not a COC for Monticello). Thus, human consumption of deer meat does not pose an excess sited-related health risk. [per Gerry Henningsen, Nov 1997]

attachments: Excel Spreadsheets on Cattle Liver and Muscle Results for Metal COCs

Monticello Beef and Deer Study Preliminary Results										11/15/96
Muscle		Accu-Labs Research, Inc.			attn: Eyda Hergenreder, 277-9514 x227					
Summary Results, Statistical Analyses, and Interim Conclusions tabulated by Dr. Gerry Henningsen										
ppm, wet wt only			Cu	Mn	Mo	V	Zn	U	Th	
RL=MDL=1/2MQL		RL =	1.0	1.0	1.0	1.0	1.0	0.2	0.2	
FDA's MDR in 75g/d meat =			22.0	33.0	0.3	0.1	200.0	0.0	0.0	
EPA default risk-bsaed concentrations =			31.0	4.0	4.0	6.0	n/a	3.0	3.0	
ug/d FDA MDA =			1650.0	2475.0	22.5	7.5	15000.0	0.0	0.0	
Group	Animal	Muscle	Cu	Mn	Mo	V	Zn	U	Th	
Control: Verdure	1		1.0	1.0	1.0	1.0	87.0	0.2	0.2	
	2		1.0	1.0	1.0	1.0	78.0	0.2	0.2	
	3		1.0	1.0	1.0	1.0	63.0	0.2	0.2	
	4		1.0	1.0	1.0	1.0	94.0	0.2	0.2	
	5		1.0	1.0	1.0	1.0	91.0	0.2	0.2	
	6		1.0	1.0	1.0	1.0	110.0	0.2	0.2	
	7		1.0	1.0	1.0	1.0	84.0	0.2	0.2	
dup of #1	8.0		1.0	1.0	1.0	1.0	80.0	0.2	0.2	
Average, without duplicate (ppm) =			1.0	1.0	1.0	1.0	86.7	0.2	0.2	
Std Dev =			0.0	0.0	0.0	0.0	14.5	0.0	0.0	
RPD of dup =			100%	100%	100%	100%	104%	100%	100%	
Group	Animal	Muscle	Cu	Mn	Mo	V	Zn	U	Th	
Middle Canyon	1		1.0	1.0	1.0	1.0	100.0	0.2	0.2	
	2		1.0	1.0	1.0	1.0	99.0	0.2	0.2	
	3		1.0	1.0	1.0	1.0	73.0	0.2	0.2	
	4		1.0	1.0	1.0	1.0	61.0	0.2	0.2	
	5		20.0	3.8	2.2	1.0	44.0	0.2	0.2	
	6		2.2	1.0	1.0	1.0	91.0	0.2	0.2	
	7		1.0	1.0	1.0	1.0	66.0	0.2	0.2	
	8		1.0	1.0	1.0	1.0	68.0	0.2	0.2	
	9		1.0	1.0	1.0	1.0	34.0	0.2	0.2	
	10		1.0	1.0	1.0	1.0	97.0	0.2	0.2	
dup of #2	11.0		1.0	1.0	1.0	1.0	160.0	0.2	0.2	
Average, without duplicate (ppm) =			3.9	1.4	1.2	1.0	65.9	0.2	0.2	
Std Dev =			7.1	1.1	0.5	0.0	22.8	0.0	0.0	
RPD of dup =			100%	100%	100%	100%	55%	100%	100%	
Group	Animal	Muscle	Cu	Mn	Mo	V	Zn	U	Th	
Lower Canyon	1		1.0	1.0	1.0	1.0	93.0	0.2	0.2	
	2		1.0	1.0	1.0	1.0	68.0	0.2	0.2	
	3		1.0	1.0	1.0	1.0	48.0	0.2	0.2	
	4		1.0	1.0	1.0	1.0	78.0	0.2	0.2	
	5		1.0	1.0	1.0	1.0	58.0	0.2	0.2	
	6		1.0	1.0	1.0	1.0	39.0	0.2	0.2	
dup of #6	7.0		1.0	1.0	1.0	1.0	84.0	0.2	0.2	
Average, without duplicate (ppm) =			1.0	1.0	1.0	1.0	64.0	0.2	0.2	
Std Dev =			.0	.0	.0	.0	19.8	.0	.0	
RPD dup =			100%	100%	100%	100%	63%	100%	100%	

Monticello Beef and Deer Study Preliminary Results										15-Nov-96
Liver		Accu-Labs Research, Inc.			attn: Eyda Hergenreder, 277-9514 x227					
Summary Results, Statistical Analyses, and Interim Conclusions tabulated by Dr. Gerry Henningsen										
ppm, wet wt only			Cu	Mn	Mo	V	Zn	U	Th	
RL=MDL=1/2MQL		RL =	1.0	1.0	1.0	1.0	1.0	0.2	0.2	
FDA's MDR in 75g/d meat =			22.0	33.0	0.3	0.1	200.0	0.0	0.0	
* EPA default risk-based concentrations =			465.0	60.0	60.0	90.0	n/a	45.0	45.0	
(* assume eat 5g liver/d RME)										
ug/d FDA MDA =			1650.0	2475.0	22.5	7.5	15000.0	0.0	0.0	
Group	Animal	Liver	Cu	Mn	Mo	V	Zn	U	Th	
Control: Verdure	1		18.0	5.2	2.7	1.0	73.0	0.2	0.2	
	2		30.0	3.0	1.7	1.0	36.0	.2	.2	
	3		41.0	3.3	1.8	1.0	51.0	.2	.2	
	4		54.0	5.4	2.5	1.0	71.0	.2	.2	
	5		17.0	4.1	1.7	1.0	44.0	.2	.2	
	6		29.0	3.0	1.6	1.0	41.0	.2	.2	
	7		49.0	5.5	2.7	1.0	62.0	.2	.2	
dup of #1	8.0		15.0	4.7	2.0	1.0	54.0	0.2	0.2	
Average, without duplicate (ppm) =			34.0	4.2	2.1	1.0	54.0	0.2	0.2	
Std Dev =			14.5	1.1	0.5	0.0	14.8	0.0	0.0	
RPD of dup =			109%	105%	115%	100%	115%	100%	100%	
Group	Animal	Liver	Cu	Mn	Mo	V	Zn	U	Th	
Middle Canyon	1		23.0	3.5	1.7	1.0	76.0	.2	.2	
	2	?Problem!	1.0	1.0	1.0	1.0	58.0	0.2	0.2	
	3		19.0	2.7	1.6	1.0	32.0	.2	.2	
	4		22.0	2.0	1.4	1.0	31.0	.2	.2	
	5		10.0	3.5	1.7	1.0	34.0	.2	.2	
	6		3.4	3.3	1.5	1.0	68.0	.2	.2	
	7		11.0	3.7	2.2	1.0	62.0	.2	.2	
	8		16.0	5.7	2.1	1.0	56.0	.2	.2	
	9		3.4	3.9	1.3	1.0	56.0	.2	.2	
	10		3.4	4.0	2.0	1.0	52.0	.2	.2	
dup of #2	11.0		25.0	5.5	3.1	1.0	66.0	0.2	0.2	
Average, without duplicate (ppm) =			11.2	3.3	1.7	1.0	52.5	.2	.2	
Std Dev =			8.4	1.3	.4	.0	15.5	.0	.0	
RPD of dup =			94%	53%	62%	100%	64%	100%	100%	
Group	Animal	Liver	Cu	Mn	Mo	V	Zn	U	Th	
Lower Canyon	1		8.9	3.9	1.8	1.0	52.0	.2	.2	
	2		25.0	4.6	1.7	1.0	45.0	.2	.2	
	3		38.0	4.5	2.0	1.0	51.0	.2	.2	
	4		25.0	4.2	1.7	1.0	51.0	.2	.2	
	5		11.0	5.3	2.2	1.0	59.0	.2	.2	
	6		9.3	2.9	1.1	1.0	30.0	0.2	0.2	
dup of #6	7.0		12.0	3.2	1.2	1.0	34.0	0.2	0.2	
Average, without duplicate (ppm) =			19.5	4.2	1.8	1.0	48.0	.2	.2	
Std Dev =			11.8	.8	.4	.0	9.9	.0	.0	
RPD of dup =			87%	95%	96%	100%	94%	100%	100%	



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466



Ref: 8HWM-SM-TS

May 28, 1996

MEMORANDUM

SUBJECT: **Revised** Study Design, Objectives and Interpretation for Sampling Tissue of Deer and Beef from Montezuma Creek

FROM: Gerry M. Henningsen, DVM, PhD, DABT/DABVT; CAPT, USPHS
Regional Toxicologist and Chair, Region 8 ETAG

TO: Paul Mushovic, 8HWM-FF
RPM

As we have more recently discussed, after the initiating R8 ETAG meeting on the Monticello NPL site held at UDEQ in Salt Lake City last August, I have revised an acceptable risk-based study design for the purpose of measuring potential tissue levels of site contaminants in deer and beef that have grazed in and been watered from Montezuma Creek. This limited study is appropriate only for obtaining exposure data that is site-specific, and the results of such a well conducted study can only support one of two possible conclusions regarding exposure (and not necessarily for quantitating risk to human health at this time):

1. Tissue concentrations are the **same** as background levels;

conclude: no significant elevations of tissue contaminants, thus no human exposure and no hazard exists from site contaminants via this route.

2. Tissue concentrations are **higher** than background levels;

conclude: tissue contaminants are elevated, denoting possible increased exposure of humans to contaminants above background levels, deserving of further study to evaluate actual exposures and potential hazards.

It is imperative for everyone to understand that this limited study is designed for the sole purpose of **screening out** the possibility of elevated exposure to contaminants through a food ingestion pathway. This study is intentionally limited to this extent because the biological and toxicological knowledge of the contaminants would lead biomedical professionals to not expect any substantial edible tissue accumulation; however, the uncertainty of biokinetics (uptake, distribution, half-lives) for some metals, radionuclides, and isotopes makes it prudent to confirm the suspected absence of site

contaminants in the beef tissue. We strongly believe that existing data and models are too weak to validly and convincingly predict tissue concentrations in exposed deer and beef that graze in the Montezuma Creek. Likewise, a rigorous and statistically strong scientific study of contaminant tissue loading is unwarranted at this time based on the low likelihood that any tissues would harbor site contaminants at elevated levels of health risk concern. Collecting site-specific exposure data by **measuring edible tissue concentrations of COCs** in exposed and reference cattle (to the limited but adequate extent described below) is felt to be a preferential approach in terms of balancing resources with usefulness of the results. It should be understood that a design which experimentally fences and grazes calves to maximize contaminant contact would be a stronger "screening-out worse-case" exposure study, but a plan of this type may be impracticable depending on the time of the season. The study design outlined below with the use of presently grazing cattle should be acceptable and represents a more realistic exposure scenario for cattle that may bioaccumulate (not necessarily biomagnify) the metals.

PLEASE NOTE: No one should draw any conclusions or make any implications regarding the fitness or health of food from results of this study. This is because the design will not support such premature health inferences, as it's limited to only screen and give **qualitative** direction for further studies that could be designed (if needed) to ascertain exposures and potential risks. Even if tissue levels of some metals are elevated above reference values, they may be entirely safe; such results wouldn't be definitive enough to imply any potential health hazard at this time.

EPA Region VIII Technical Proposal for a Study Design

TITLE: Comparison of Tissue Concentrations of Selected Metals in Deer and Cattle Grazed near Montezuma Creek (above Vega Creek) vs Reference Areas to Screen for Exposure.

PURPOSE: Measure edible-tissue concentrations of contaminants of concern in exposed beef and deer compared to reference areas, in order to determine if human consumers may be potentially exposed to elevated concentrations of these metals from the Montezuma NPL site via this dietary pathway. This evaluation is only a screening-level study to decide whether additional attention is needed to assess actual quantitative exposures and hazards to humans from contaminants through this route of possible exposure.

Null Hypothesis (to test and try to scientifically disprove):

Tissue levels of contaminants of concern (metal amounts or gross radioactivity) are the same in deer and cattle grazed in/near Montezuma Creek compared to cattle grazed in reference areas (as analyzed in muscle, liver, kidney and bone samples).

Test Statistic: A **one-tailed t-test** can be used to compare the two groups for each tissue and contaminant combination (a two-tailed t-test is not used since any change should only be in one direction above background levels). If there is statistical probability of $\alpha \leq 0.05$ for exposed tissue levels being higher than controls, then reject the null hypothesis and conclude that significant difference exists between the two groups for a particular tissue type and contaminant. Therefore, potential exposure to humans via this ingestion route would not be able to be screened out. Conversely, if $\alpha \geq 0.05$ for all tissue and contaminant combinations in a study that is reasonably well conducted, then the null hypothesis is accepted and exposure via this route is able to be screened out with no further evaluation being necessary.

For $0.05 \leq \alpha \leq 0.1$, denoting a possible significant trend, then the data distributions of individual animal results will be evaluated to make a professional interpretation of whether there is or is not any substantial exposure to be indicative of a screening-level need for further study of exposure and health hazards.

Treatment groups: Three treatment groups of beef and two treatment groups of deer are proposed for comparisons, based upon the primary difference being the presence or absence of exposure to Monticello NPL site contaminants. Individuals comprising the groups should be matched as closely as possible in terms of age, breed, sex, weight, general health, proximity, and feeding characteristics.

We recommend the purchase of either steers or heifer calves from two ranches that are reasonably similar in all major aspects except for grazing access to Montezuma Creek near the NPL site. Exposed calves should have documented access to the contaminated water, soil, and vegetation in this area of Montezuma Creek from at least June or July through September. The calves (ideally near market weight of 1000 lb.) should be acquired prior to or shortly after their removal (within 5 days) from the Montezuma Creek area.

Deer will be collected by the Utah Division of wildlife from two herds. The exposed group will come from the resident deer herd living in and near the middle canyon of Montezuma Creek, while the reference herd can be sampled that is as similar as possible.

Sample size and characteristics: A sample size of at least 6 animals per each of the groups should be tested in this study. It would be preferable (as close as possible) to test calves that are between 6 to 12 months old, since their relatively low weight and faster growth would correspond to greater intakes of media which would in turn strengthen the biomedical confidence for acceptance of the null hypothesis. Timing of sample collections should be within the same week, and samples should be taken from calves that have had at least 3 months of documented exposure at either the exposure or reference site. The late summer or early fall would be best times to sample the animals under the above conditions. Deer should be healthy-appearing

young adult bucks of similar age. This design would produce 5 groups (3 beef and 2 deer) of at least 6 animals in each for a total of about 30+ individuals collected and sampled.

While abiotic samples are being or have been collected to define contaminant levels in those media, no such samples were collected for analysis in the reference area of the control calves; therefore, it is recommended that a reasonable number of **representative samples of soil, water and vegetation be collected** for similar background analysis when the control calves are purchased and removed from the ranch.

Tissue collections, preparations, and storage: Following humane procedures for collecting deer and euthanizing cattle, clean and ample amounts (specified by analytical laboratory requirements) of muscle, liver, middle rib and kidney should be collected for both testing and archiving (-20° F) in case of a need for reanalysis. A veterinarian (large animal clinician or pathologist) should be present to inspect the clinical health of sampled deer and cattle and to perform a necropsy to observe for any gross lesions. The purpose of such exams is to help interpret unusual contaminant concentrations that may be the consequence of poor health rather than due to a possible treatment effect. Clean, uncontaminated containers and instruments will be used to harvest samples of muscle, liver and kidney. A uniform locale of tissues from organs should be achieved, and kidney samples should include at least 50% cortical tissue in the sections. Separate, clean, freezer containers should be used for archiving similar tissue samples. All containers must be thoroughly labeled and chain-of-custody maintained. A blind **duplicate sample should be submitted from each group** for determining laboratory reproducibility of test results. Tissue preservation methods directed by the analytical lab should be used, and any reagents should be tested to confirm the absence of significant amounts of the test analytes (no contamination).

Calves should be taken to a local slaughter house or to a large animal veterinary clinic or to a veterinary diagnostic laboratory for tissue collections. Suggested uniform tissue sizes and locales are: 250 g from the round cut of meat in the rear quarter, 100 g of liver taken from two distant areas in the organ, and 50 g of kidney from split samples from each kidney. A rib for analysis and an archived bone sample from the femur or humerus (thigh bone or upper front leg bone) just below the growth plate is recommended to be taken and held in case results suggest a need to use bone for verification of certain analyte levels in the near future. Double bags with zip-locks can be used for archive freezer storage, and the archives can be discarded after the ETAG agrees that the study is conclusive for its designed purpose and that the samples would not require reanalyses. The carcasses can be safely sold to the local slaughter house to help defray costs, unless we wish to avoid any wholesomeness inferences and thus send **exposed** cattle to a rendering company. The calves may actually be too small to be worth butchering and selling the meat.

Laboratory and other analyses: Gross lesions or clinical problems should be noted in a necropsy report, and if the attending veterinarian is not confident of their cause, relevant samples should be submitted to a veterinary laboratory for culture or pathology to aid diagnosis. This situation should be a rare event with healthy young cattle, considering the screening nature of this study involving uptake of metals and distributions in tissue. The metallic COCs (Cu, Mo, Mn, U, Th, V; and radionuclides: K, Ra, Th, and U) should be measured by a suitable analytical method that attains adequate detection and quantitation limits (below conservative, default, risk-based concentrations for human intake). In addition, suitable methods for measuring gross radiation (gamma, alpha, and beta) in the tissue samples must be used, and detection limits should be down to at least the background levels found in local uncontaminated soils. Risk-based tissue concentrations can be provided to the laboratory by Region 8 toxicologists. This design should produce about 140 tissue samples (with 1 duplicate set per group) plus a few abiotic samples from the reference site.

Quality control and study/data quality: Laboratory accuracy and precision for the method must be acceptable for the analyses. Calibration standard curves, lab replicates, blanks, and field duplicate results must be reported and interpreted. Any factors that may have influenced the results should be discussed and interpreted to the extent possible as to the impact on usefulness of the data.

Report: A report of all the final study design characteristics, sample collections and analyses, and data quality with results should be presented. Simple statistical tests of group treatment differences should be performed and presented as discussed above. All raw data and summary results of both data and statistics (means, standard deviations, ranges, etc.) should be tabulated. Results should be interpreted to qualitatively estimate the bioavailability of the metal COCs for the beef. Reports should be available within 30 days of receipt of acceptable lab results.

Additionally, if the DOE and consultants desire and the data are appropriate, an improved (vs default literature) estimate of site-specific biological transfer factors of COCs from vegetation to beef is feasible for potential future use in models designed to estimate human exposure through a beef ingestion pathway. This latter scenario is possible if there is low variance in data obtained from the small sample sizes, and if adequately representative samples have been collected.

attachment: Aug 95 Draft Study Design for Beef Study

copy: Mark Wickstrom, 8HWM-SM
Mario Robles, 8HWM-FF
Jay Silvernale, 8HWM-FF
Scott Everett, UDEQ



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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<http://www.epa.gov/region08>

EPR-PS

July 19, 2000

To: Paul Mushovic
RPM, Monticello Mill Tailings Site

From: Dale Hoff 
Regional Ecotoxicologist

Reference: Review of the Baseline Ecological Risk Assessment for OUIII soil and sediment area.

Paul,

At your request I have looked at the above referenced information. Specifically, I have focused on the summary information provided to me entitled: Monticello Mill Tailings Site, Operable Unit III, Baseline Risk Assessment Information Part 1: Ecological Risk Assessment. Your request was to review the exposure pathway information and Toxicity Benchmarks to identify any potential problems regarding more recent information that could significantly change the interpretation of the risk characterization.

General Comment

Although the science and practice of ecological risk assessment is evolving and improving, absolute values of some of the benchmarks and benchmark practices described below, have not changed in a manner I believe to significantly alter the risk interpretations from the original risk assessment. I do however believe that as result of improved methods in assessing risks to benthic invertebrates, some limited, cost efficient follow-up sampling of this community may gain some incite into the effectiveness of the remedy. I would not recommend sampling the invertebrate community until after remedial action is complete enough such that ongoing physical disruption and sedimentation of the creek is limited.

Specific CommentsExposure:

1. Exposure pathways of groundwater and air should still remain as negligible pathways unless remedial action of any sort has lead to contaminated groundwater surfacing at a previously unidentified spot.



2. No new information is available that would require changing any of the exposure parameters for the wildlife species.

Effects:

3. Toxicity Reference Values For Wildlife. Attached you will find a table labeled: Table 10-8. Summary of Terrestrial TRVs. This table is from a recent release of the Clark Fork River Risk Assessment. We have included updated information in these TRVs since the OUIII document was completed. You can compare 5 metals and similar species (e.g. mule deer vs. white-tailed deer, by our uncertainty factor scheme, these two species would have the same value anyway.) Also attached is a scatter plot of cobalt toxicity data in mammals. It illustrates several different endpoints and is part of a new draft guidance document in the development of national ecological soils screening values as a proposed mammalian Toxicity Reference Value. As you will see as you study OUIII's and the other two sources of TRVs side by side, they exhibit very similar numbers. Nearly all are within the same order of magnitude and neither sets of values are consistently more or less conservative. Therefore, I do not believe the differences in the updated toxicity reference values would alter interpretations from Hazard Indices in the OUIII ecological risk assessment.

4. Toxicity Benchmarks for Sediments:

The OUIII ecological risk assessment identified potential risk to benthic invertebrates in portions of the creek. A hazard quotient analysis was completed comparing ERM (NOAEL) and NEC (LOAEL) values from Ingersol et al (1996) to sediment concentrations on site. There was also demographic data of limited quantity to look at the health of the benthic community.

As an update, the region has stopped using the ERM and the NEC as NOAELs and LOAELs. Instead, we now use the ERL (Effect Range Low) as the NOAEL and the ERM (effect range medium) as a LOAEL. Attached is page 7-6, again from the Clark Fork River Ecological Risk Assessment. It illustrates these updated values. The change has come about for several reasons: 1.) These sediment benchmark values are limited to being only very useful for screening as they are not very predictive of toxicity. As an example, I have included page 7-8 of the CFR ERA which includes site-specific numbers derived from toxicity tests on actual site sediment. As you can see from the table, actual bulk sediment concentrations leading to toxicity are much higher than those illustrated by ERM and ERL values; 2) The Ingersol bulk sediment values are derived from several sites that had other contaminants than the metal of interest. Therefore, toxicity derived from completely unrelated compounds reduces the ERL value; 3) Since they have only limited use for screening we chose the lower numbers so that we could have high confidence of having no risk. Another big change in our application is that we no longer add all the HQs to sum an HI. As noted in the text on the attached page 7-6, since the results of the ERL and ERM values already reflect the interaction of multiple metals, we do not feel that is appropriate to sum up the HQs. Since the original OUIII risk assessment summed the values to an HI, the overall impact to the predicted risk from the change in practice by the region should be minimal, and I do not recommend changing anything at this time.

I would, however, recommend some follow-up work looking at the benthic macroinvertebrates. Using this community as an indicator for improvement and reduction (hopefully) of risk to this system. This biological data would be especially important because several physical changes have occurred since the original risk assessment. Much of the original work may not be very comparable. Therefore, it is important to begin collecting some baseline data as soon as appropriate to determine if any improvement to the system is occurring through the use of this biological indicator. However, if some of the same stations can be used from the original risk assessment, that may also be useful. Looking at the benthic community before and after remedial action will hopefully demonstrate evidence of a successful remedy in the future.

5. Unfortunately, no new information is available for looking at development of TRVs for uranium. We have maintained a search for new and better information and have not found anything.

TABLE 10-8 SUMMARY OF TERRESTRIAL TRVs

Receptor	Chemical	NOAEL (mg/kg-d)		LOAEL (mg/kg-d)	
		Water	Diet	Water	Diet
Range Cattle	Arsenic	1.7E-01	3.3E-01	2.5E-01	5.0E-01
	Cadmium	6.2E-02	1.2E-01	1.8E-01	3.7E-01
	Copper	1.1E+00	2.2E+00	3.3E+00	6.7E+00
	Lead	6.7E-02	1.5E+00	2.0E-01	4.5E+00
	Zinc	1.7E+00	1.0E+01	5.0E+00	2.0E+01
White-tail Deer	Arsenic	1.7E-01	3.3E-01	2.5E-01	5.0E-01
	Cadmium	6.2E-02	1.2E-01	1.8E-01	3.7E-01
	Copper	2.2E+00	4.4E+00	6.7E+00	1.3E+01
	Lead	2.2E-02	1.5E+00	6.7E-02	4.5E+00
	Zinc	1.7E+00	1.0E+01	5.0E+00	2.0E+01
Red Fox	Arsenic	2.5E-01	2.0E-01	7.6E-01	6.0E-01
	Cadmium	1.7E-01	5.0E-01	5.0E-01	9.9E-01
	Copper	4.4E+00	2.2E+00	6.4E+00	3.2E+00
	Lead	2.1E-01	4.2E-01	4.1E-01	8.2E-01
	Zinc	3.9E+01	7.8E+01	1.2E+02	2.3E+02
Masked Shrew	Arsenic	2.5E-01	5.1E-01	7.6E-01	1.5E+00
	Cadmium	1.7E-01	5.0E-01	5.0E-01	9.9E-01
	Copper	7.6E-01	3.4E+01	1.8E+00	7.2E+01
	Lead	4.2E-02	8.3E-02	1.3E-01	2.5E-01
	Zinc	1.2E+01	2.4E+01	2.4E+01	4.8E+01
Deer Mice	Arsenic	1.3E+00	2.5E+00	3.8E+00	7.6E+00
	Cadmium	8.3E-01	8.3E-01	2.5E+00	1.7E+00
	Copper	3.8E+00	1.7E+02	9.0E+00	3.6E+02
	Lead	2.1E-01	4.2E-01	6.3E-01	1.3E+00
	Zinc	2.0E+01	4.0E+01	4.0E+01	8.0E+01
American Robin	Arsenic	4.1E-01	8.1E-01	3.5E+00	7.1E+00
	Cadmium	4.3E-02	8.7E-02	1.2E+00	2.4E+00
	Copper	2.0E+00	4.0E+00	3.0E+00	6.0E+00
	Lead	4.4E-01	8.8E-01	8.8E-01	1.8E+00
	Zinc	1.3E+01	2.6E+01	3.9E+01	7.9E+01
American Kestrel	Arsenic	4.1E-01	8.1E-01	3.5E+00	7.1E+00
	Cadmium	4.3E-02	8.7E-02	1.2E+00	2.4E+00
	Copper	2.0E+00	4.0E+00	3.0E+00	6.0E+00
	Lead	4.4E-01	8.8E-01	8.8E-01	1.8E+00
	Zinc	1.3E+01	2.6E+01	3.9E+01	7.9E+01
Mink	Arsenic	2.5E-01	1.5E-01	7.6E-01	4.5E-01
	Cadmium	1.7E-01	5.0E-01	5.0E-01	9.9E-01
	Copper	1.8E+01	8.8E+00	2.6E+01	1.3E+01
	Lead	1.6E-01	3.1E-01	3.1E-01	6.1E-01
	Zinc	1.6E+02	3.1E+02	4.7E+02	9.3E+02
Bald Eagle <i>Peregrine</i>	Arsenic	2.3E-01	4.7E-01	2.0E+00	4.0E+00
	Cadmium	2.5E-02	4.9E-02	6.8E-01	1.4E+00
	Copper	1.3E+00	2.7E+00	2.0E+00	4.0E+00
	Lead	2.9E-01	5.8E-01	5.8E-01	1.2E+00
	Zinc	8.7E+00	1.7E+01	2.6E+01	5.2E+01
Great Blue Heron	Arsenic	4.1E-01	8.1E-01	3.5E+00	7.1E+00
	Cadmium	4.3E-02	8.7E-02	1.2E+00	2.4E+00
	Copper	2.0E+00	4.0E+00	3.0E+00	6.0E+00
	Lead	4.4E-01	8.8E-01	8.8E-01	1.8E+00
	Zinc	1.3E+01	2.6E+01	3.9E+01	7.9E+01
Mallard Duck	Arsenic	2.0E+00	4.1E+00	1.8E+01	3.5E+01
	Cadmium	2.2E-01	4.3E-01	6.0E+00	1.2E+01
	Copper	2.0E+00	4.0E+00	3.0E+00	6.0E+00
	Lead	4.4E-01	8.8E-01	8.8E-01	1.8E+00
	Zinc	1.7E+00	3.5E+00	2.1E+01	4.2E+01

NEC is defined as the maximum concentration of a chemical in sediment that did not significantly adversely effect the particular response compared to the control.

For the purpose of this assessment, the ERL derived by Ingersoll (1996) is identified as the NOAEL TRV and the ERM derived by Ingersoll (1996) as the LOAEL TRV. The values developed by Ingersoll et al. (1996) are considered to be preferred to NOAA and Ontario values because they are based on freshwater observations only and include some data from the Clark Fork River. These values are summarized below for each of the chemicals of concern. For convenience, the NOAA ERM and Ontario SET values previously used by the State of Montana are also shown. As seen, the criteria developed by Ingersoll et al. (1996) are generally lower than the ranges used by the State.

Chemical of Concern	Sediment TRV ^a (mg/kg)		NOAA ERM (mg/kg)	Ontario SET (mg/kg)
	Ingersoll ERL (NOAEL)	Ingersoll ERM (LOAEL)		
Arsenic	13	50	50	33
Cadmium	0.7	3.9	5	10
Copper	41	190	300	110
Lead	53	99	300	250
Zinc	110	550	260	820

^a Source: Ingersoll et al. 1996

An important characteristic of these TRVs is that they are based on sediment toxicity tests and field studies of bulk sediments contaminated with mixtures of chemicals, and the spectrum of toxic chemicals present in the sediment may vary from site to site and from sample to sample. Thus, for sediment samples that are found to cause toxicity in exposed benthic organisms, it is not possible to know which chemical (or combination of chemicals) is responsible for the observed effect. Therefore, the concentration of any specific chemical in a sediment sample causing toxicity may or may not be a reliable indicator of the toxicity of that particular chemical, depending on whether or not it is the principal source of toxicity in that sample. Rather, the concentration of a particular chemical should be viewed as a general index of the level of contamination of the sediment by the mixture of chemicals present, and the ratio of the concentration of a specific metal divided by the chemical-specific TRV for that metal should be interpreted as an HI, not an HQ. For this reason, summation of HI values across the different indices (chemicals) is not appropriate.

Predicted Hazards Based On Ingersoll's Sediment Effects Concentration Values

Table 7-4 presents the range of HI values predicted for sediments from the Clark Fork River based on the SEC values derived by Ingersoll et al. (1996). These results are summarized graphically in Figure 7-14. Inspection of these data reveals that sediments are predicted to be of concern to benthic organisms regardless of which chemical is selected as the indicator of mixture levels, although the values based on copper tend to be larger than for other indices of contamination.

5 summarizes the results of *Hyalella* toxicity studies that were performed using sediment samples collected from Silver Bow Creek, Warm Springs Ponds, the Clark Fork River, and Milltown Reservoir. Even though these sediments are not all from within the same Superfund site, they are all from contiguous areas that are likely to be contaminated with very similar materials. These data are displayed graphically in Figures 7-15 to 7-19. It should be noted that statistically significant increases in mortality were not observed in any samples of sediment from the Clark Fork River itself.

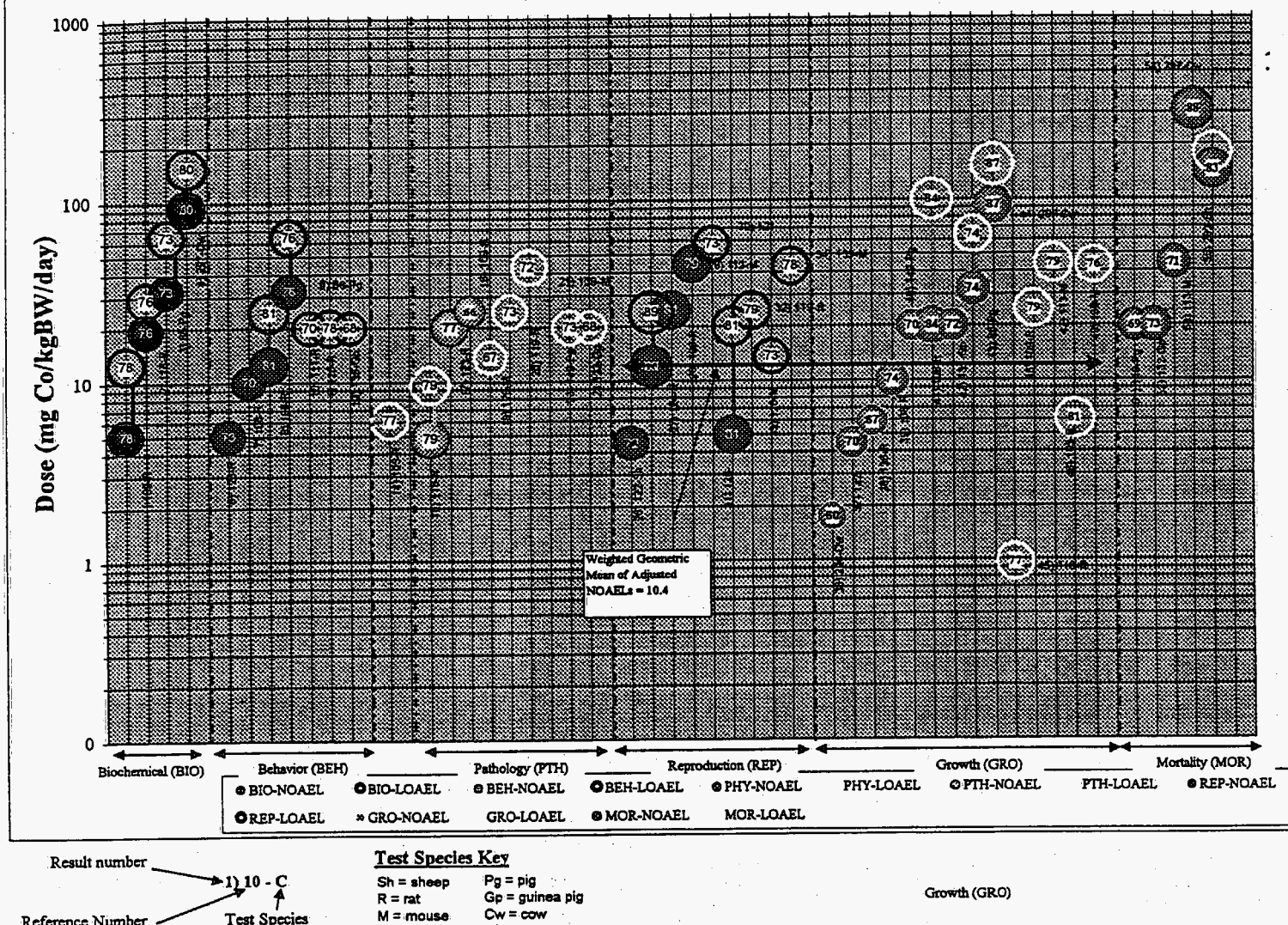
These data were used to identify a site-specific LOAEL for each metal, defined as the lowest concentration in any sample that resulted in a statistically significant increase in *Hyalella* mortality. To be conservative, the NOAEL for each metal was assumed to be ½ the LOAEL (rather than the highest concentration below the LOAEL which did not cause a statistically significant increase in mortality). These site-specific sediment TRVs are summarized below. For convenience, the sediment TRVs identified by Ingersoll et al. (1996) are also shown for comparison.

Chemical	Site-Specific TRV (ug/g)		Ingersoll et al. 1996 TRV (ug/g)	
	NOAEL	LOAEL	NOAEL	LOAEL
Arsenic	115	230	13	50
Cadmium	4.93	9.86	0.7	3.9
Copper	1125	2250	41	190
Lead	86.5	173	53	99
Zinc	1385	2770	110	550

As seen, sediment TRVs based on mortality in *Hyalella* exposed to sediments from the Clark Fork River and adjacent sites (Silver Bow Creek, Warm Springs Ponds, Missoula Reservoir) are all higher than those derived by Ingersoll et al. (especially for copper). This is consistent with the hypothesis that toxicity in some sediments used by Ingersoll et al. were due to chemicals other than metals. However, the difference may also be due in part to use of lethality as the endpoint, rather than decreased growth or other more sensitive endpoints.

Table 7-6 summarizes predicted HI values for exposure of benthics to bulk sediment, based on these site-specific sediment TRVs. These results are summarized graphically in Figure 7-20. Inspection of these data show there is no evidence of hazard to benthic organisms based on the LOAELs, and only marginal hazard based on the NOAELs. This indicates that Clark Fork River sediments pose a low hazard of increased mortality in *Hyalella* and organisms of similar or lesser sensitivity to metals. However, the possibility remains that organisms more sensitive than *Hyalella* could be adversely affected by metals in site sediments.

Figure 4.1 Mammalian TRV Derivation for Cobalt



Wildlife TRV Derivation Process

- 1) There are at least three results available for two test species within the GRO, REP and MOR effect groups. There is enough data to derive TRV.
- 2) There are at least three NOAEL results available for calculation of a weighted geometric mean.
- 3) The weighted geometric mean of the adjusted NOAEL values for GRO and REP equals 10.4 mg Co/kg BW/day.
- 4) The weighted geometric mean NOAEL value is less than the lowest reported LOAEL for mortality.
- 5) The mammalian wildlife TRV for cobalt is equal to 10.4mg Co/kg BW/day.